SOIL FAUNA UNDER MAJOR SHRUBS IN GRAZED AND PROTECTED PLOTS AT THE OMAYED BIOSPHERE RESERVE. I.- POPULATION DENSITY.

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RESUME

Dans le cadre d'une étude sur les effets de l'aménagement du territoire en zone littorale, dans la Réserve de la Biosphère d'Omayed (83 km à l'ouest d'Alexandrie), la faune du sol a été échantillonnée dans des parcelles protégées du pâturage pour 13 ans (1974-1987), ainsi que d'autres parcelles voisines de libre pâturage, d'au-dessous de quatre espèces d'arbustes : *Anabasis*, *Thymelaea*, *Gymnocarpos* et *Artemisia*. Les données ont été traitées par l'analyse de correspondances et la classification hiérarchique ascendante. Les résultats montrent que la faune du sol sous *Thymelaea* (le passerin), dans les parcelles à libre pâturage est clairement distincte, tandis que celles de *Gymnocarpos* protégé et *Anabasis* libre sont fort semblables. Pourtant on a pu distinguer les espèces de la faune du sol associées aux zones de libre pâturage et celles plus fortement associées aux zones protégées.

ABSTRACT

Soil fauna were collected under major shrubs in grazed and protected plots at the Omayed Biosphere Reserve. Data were treated by the methods of correspondence analysis and ascending hierarchic classification. Results of ordination show that soil fauna under *Thymelaea* shrub in the free grazing area is quite distinct. In general, fauna of free grazing plots could be distinguished from that of protected ones.

INTRODUCTION

Changes in populations of soil fauna under various land use types were the subject of studies aiming to understand their usefulness as indicators of environmental conditions prevailing in various habitats (Ghabbour, 1988). In the coastal habitats of the Mariut region west of Alexandria, studies were carried out at the littoral sand dunes (Ghabbour et *al.*, 1977) and in the inland non-saline depression at Omayed (Ghabbour and Mikhail, 1978 ; Cancela da Fonseca et *al.*, 1984). These studies have shown the impact of grazing pressure and conservation on populations of soil fauna at these sites. At Omayed, plots were protected from grazing starting in 1974, and it was declared a Biosphere Reserve by UNESCO in 1981.

The purpose of the present study carried out in 1987 was to evaluate changes in populations of soil fauna due to prolonged protection from grazing in the Omayed Biosphere Reserve, as part of the Mariut area.

MATERIAL AND METHODS

The study area comprises about 48 ha declared by UNESCO/MAB as the Omayed Biosphere Reserve in 1981. It is located about 83 km W of Alexandria and 10 km S of seashore. It has been classified as part of the "Attenuated xero-Mediterranean climatic province of Egypt" (Ayyad et al., 1984). Vegetation consists mainly of *Anabasis articulata*, *Thymelaea hirsuta*, *Artemisia monosperma*, and *Gymnocarpos decanderum* shrubs, with a number of other

shrubs and herbs (Ayyad and El-Kady, 1982). An experiment of protection from grazing has been carried out since 1974. In 1977, a part (14 ha) was separated and subjected to 50 % grazing freely practised outside the exclosure (100 % grazing pressure). At the same date, two other plots, each of 14 ha, were also fenced off. One was subjected to 50 % G.P. and the other to 25 % G.P. (Ayyad and El-Kady, 1982). The grazing animals are sheep and goats.

The method of sampling soil mesofauna was described by Ghabbour et *al.* (1977). Briefly, it consists of digging the soil under the canopy of the shrub selected for sampling and passing it through 1-mm mesh sieve, until animals and litter are no longer obtained. Samples were taken under the 4 shrub species mentioned above in the grazed and protected plots during summer 1987. Selection of shrubs was random. Five shrubs were sampled from each plant species from grazed and protected plots, except for protected *Thymelaea* (n=2) and grazed *Artemisia* (n=4). The extracted fauna were counted and kept in 70 % ethanol. Identification was possible to the species level in most cases, using comparisons with authentically identified specimens.

Soil mesofauna data were treated by means of correspondence analysis, CA, (Greenacre, 1984) and ascending hierarchic classification, AHC, (Roux, 1985). The computer calculations for CA and AHC were carried out at Cairo University using a DATAVISION programme 1.2 (Roux, 1987) developed for APPLE IIe in BASIC.

RESULTS AND DISCUSSION

Soil fauna collected in the study could be grouped into 13 species. The population density per square meter and taxonomic classification of these species are shown in Table (1). Figure 1 shows graphic representation of ordination techniques, CA and AHC, applied to data in Table (1). Thirty two % of the total variance is associated with the first axis and 21 % with the second one. It can be seen that the fauna of *Thymelaea* in the free-grazing plot is quite distinct, characterized by *Monomorium* and *Bradycellus* and forming a separate group along the first (horizontal) axis. This group caused the clustering of two other groups at the other end of the first axis. These two groups were separated along the second (vertical) axis, which separates grazed and protected plots with characteristic soil fauna. The fauna of protected *Anabasis*, *Artemisia*, and *Gymnocarpos* and unprotected *Anabasis* are very similar, and consist mainly of *Heterogamia* (adults and nymphs), *Dendarus*, *Machlopsis*, and scorpions. Soil animals of protected *Thymelaea* and unprotected *Artemisia* and *Gymnocarpos* are very similar and consist of snails, Sphegidae, *Scarites*, *Otiorhynchus*, *Crypticus*, *Erodius*, and *Psammobius*.

It is noticed that the unprotected plots are more diverse in species than the protected one. This agrees with earlier findings obtained by Ghabbour and Hussein (1982), and may be due to the equilibrium attained between the negative factor of trampling by domestic animals and the positive factor of urine and dung production at maximum stocking rate (Ghabbour and Hussein, 1982). Protection from grazing has resulted in improvement in primary production and phenological behaviour of the plant species (Ayyad and El-Kadi, 1982). This will lead to changes in density of soil fauna faster than that of vegetation (Ghabbour and Hussein, 1982). Therefore, total population density of soil animals under the protected *Anabasis* and *Thymelaea* are higher than those of the grazed counterparts. On the other hand, the total density of soil fauna is higher under the grazed than under the protected *Gymnocarpos* due to the presence of the snail (*Eremina*) and *Otiorhynchus* (Curculionidae) in higher numbers under the latter. Both protected and unprotected *Artemisia* have nearly the same densities (Table 1). The similarity of unprotected and protected *Anabasis* (Fig. 1) is due to the fact that *Anabasis* has a dense branching forming a cushion-like growth-form which protects the soil and its denizens (Ghabbour and Mikhail, 1978). The unprotected *Thymelaea* is separated away, since it has a V-shaped branching above the ground, creating conditions unsuitable for soil animals. Results obtained from this study reveal that with prolonged protection, soil fauna tend to adapt themselves to conditions present in their environment. This is appearent in the case of sand roaches (*Heterogamia syriaca*) which were associated in a previous study in 1980 with the grazing plots (Cancela da Fonseca et *al.*, 1984), but in 1987 were more associated with the protected plots. With prolonged protection, the

			Grazed				Protected			
			A	T	R	G	A	T	R	G
No	Fn	Species n =	5	5	4	5	5	2	5	5
		Mollusca								
1	P	Eremina desertorum	0	0	0	6,2	0	0	0	1
		Dictyoptera								
2	D	Heterogamia syriaca a.	0,8	0	0	2,5	1,3	0	0,3	0
3	D	H. syriaca n.	0,3	0,6	0	3,1	2,1	0	0.6	6
		Hymenoptera								
		Sphegidae	0,4	0,4	0,4	0	0	0	0	0
		Formicidae								
5	P	Monomorium salomonis	0	2,3	0	0	0	0	0	0
		Coleoptera								
		Carabidae								
6	C	Bradycellus lusitanicus	0	0,6	0	0	0	0	0	0
7	C	Scarites buparius	0	0,4	1,3	2,5	1,3	0	0	0
		Curculionidae								
8	P	Otiorhynchus sp.	1,2	0	0	7,7	0	6	0	1,5
		Tenebrionidae								
9	D	Cripticus murinus	0	0	1,3	0,9	0	0	0	0
10	D	Dendarus piceus	0,5	0	0	0	1,5	0	1,2	0
11	D	Erodius gibbus	0	0	0,4	0	0	0,9	0	0
12	D	Machlopsis crenatocostata	0,4	0	0	0	0	0	0	0
		Scarabaeidae								
13	D	Psammobius porcicollis	0	0,2	0,4	0	0,5	0,9	0	0
14	C	Scorpion	0	0	0	0	0,3	0	0	0
		Total	3,6	4,5	3,8	22,9	7,0	7,8	2,1	8,5

A = Anabasis ; T = Thymelaea ; R = Artemisia ; G = Gymnocarpos ; D = Detritivores ; C = Carnivores ; P = Phytophagous ; a = adult ; n = nymph

Table 1 : Population density of soil fauna (summer 1987) under major shrubs at Omayed Biosphere Reserve.
A = *Anabasis*, T = *Thymelaea*, R = *Artemisia*, G = *Gymnocarpos*, D = Detritivores, C = Carnivores, P = Phytophagous, a = adult, n = nymph.

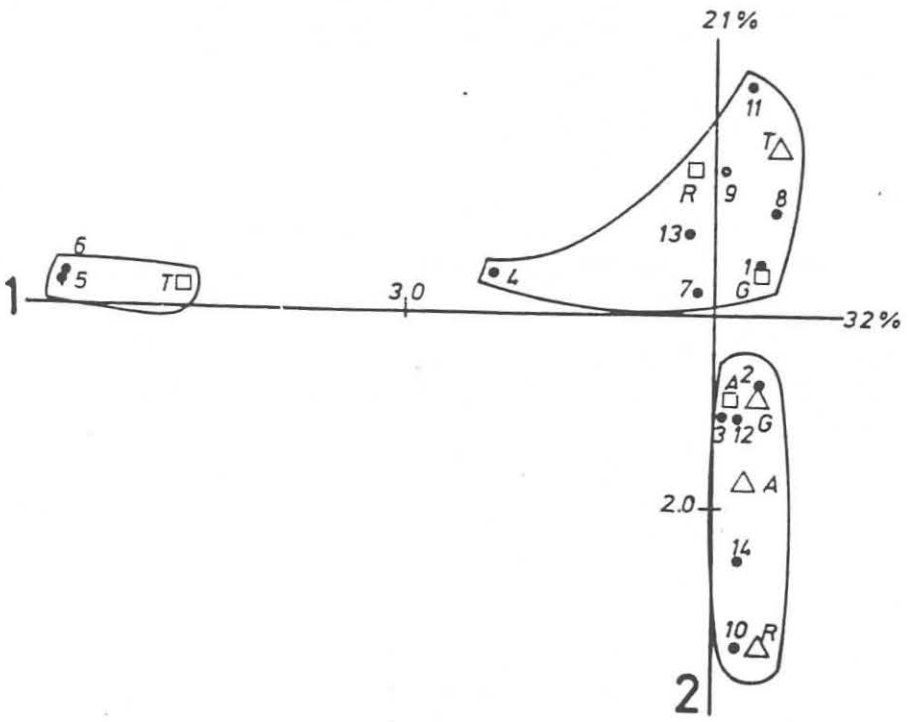

Fig. 1 : Graphic representation(with minor modifications) of the results of ordination by the CA method with the result of groupings by AHC method of the data of population densities of soil fauna of table 1. Shrub species : A, *Anabasis* ; T, *Thymelaea* ; R, *Artemisia* ; G, *Gymnocarpos*. Conditions : squares, free-grazing plots : triangle, completely protected plots. Numbering of species (1-14) as in table 1.

compaction of soil which occurred in the early period (1974-1980), caused the gradual elimination of sand roaches, but in later periods (1980-1987), accumulation of new layers of unconsolidated sand allowed the return of sand roaches. The harvester ants which were abundant in the protected plots in 1980 were absent in 1987. The ratio of herbivores : carnivores : detritivores under the shrubs in the gazed plots is 44 : 0 : 56 for *Anabasis*, 60 : 22 : 18 for *Thymelaea*, 11 : 34 : 55 for *Artemisia*, and 61 : 11 : 28 for *Gymnocarpos*. In the protected plots this ratio is 0 : 23 : 77 for *Anabasis*, 77 : 0 : 23 for *Thymelaea*, 0 : 0 : 100 for *Artemisia*, and 29 : 0 : 71 for *Gymnocarpos*.

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